REMARKS

This amendment is responsive to the Office Action of June 23, 2004. Reconsideration and allowance of claims 31-42 and 44-47 are requested.

Status of the Claims

Claims 1-47 are pending.

Claims 28-30 stand withdrawn from consideration.

Claims 31, 39, 40, 41, and 45 are amended.

Claims 1-27 and 43 stand allowed.

The Office Action

Claims 1-27 and 43 were allowed.

Claims 31-34, 39-42, 44, and 45 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Mowli (US 4,792,294).

Claims 35-38, 46, and 47 stand rejected as being unpatentable over Mowli in view of an alleged choice of design well-known in the art.

MPEP 2144.03 & 2144.04

Applicants reiterate their traversal of the applied "well-known" art under MPEP 2144.03 and 2144.04, discussed in the prior response.

The Mowli Reference

Mowli discloses a two stage pumping apparatus for pumping highly viscous liquids, such as cheeses (col. 1, lines 15-26, and col. 2, lines 13-16). The pump is vertically oriented with an upper infeed opening **14** to allow gravity feed. To solve infeed problems, a first stage consisting of an "Archimedian" spiral or screw **36** precedes a second stage consisting of two screw rotors **40** (col. 5, lines 1-20). The pump of Mowli uses a "non-positive displacement pumping action" in the first stage to feed the positive displacement second stage (col. 2, lines 61-65).

For gases, particularly those under a vacuum (i.e., at below atmospheric pressure), a non-positive displacement pumping action of the type

described by Mowli, is ineffective. See the discussion of why positive displacement pumps are important for vacuums on pages 129-130 of Theory & Practice of Vacuum Technology by M. Wutz, et al. (copy enclosed). Because these referenced text pages are submitted by applicant for definitional purposes rather than prior art, no PTO 1449 is enclosed. The non-positive displacement stage of the Archimedian spiral of Mowli does not serve to transport gas volumes.

The Claims Distinguish Patentably Over the References of Record

Claims 28-30 are directed to non-elected claims pursuant to a Restriction Requirement. When the application is otherwise fully in condition for allowance, the Examiner may take appropriate action of **claims 28-30** by Examiner's Amendment pursuant to MPEP 821.01.

Claim 31 calls for a pair of rotors which have inter-engaging helical threads extending from adjacent an inlet port to adjacent an exhaust port. Claim 31 further calls for a lobe mounted adjacent the inlet port end of one of the helical threads and a channel defined adjacent the inlet port end of the other thread. The lobe and channel cooperate to form a suction section adjacent the inlet port which is intermittently closed from the inlet port.

Support for the amendments to claim 31 are to be found in the specification at page 9, lines 16-25, and in FIGURES 12 and 13.

Mowli makes no suggestion of forming a suction section which is closed from the inlet port. Rather, the Archimedian screw portions **36** of Mowli's rotors, which the Examiner suggests are a lobe and channel, are specifically designed for non-positive displacement. There is no intermittent closing of a suction section by theses helical portions.

Further, it should be noted that the pair of Archimedian screws do not seal to each other. Rather, if one were to try to use the Mowli pump against its express instructions that it should be used for highly viscous liquids, then the Archimedian screws would perform no vacuum pumping function. The Archimedian screws create a continuous flow path between the inlet (vacuum side) and the positive displacement screw pump. The entire section around the Archimedian screws would be at the same vacuum side pressure. While

Archimedian screws are effective for encouraging highly viscous materials (which are too viscous to move downward through an inlet by gravity) to move downward through the inlet, they are ineffective for pumping gases to draw down a vacuum.

Accordingly, it is submitted that **claim 31 and claims 32, 35-38, 42, and 44 dependent therefrom** distinguish patentably and unobviously over the reference of record.

Claim 39 now calls for a vacuum pump for pumping a gas which includes a pump chamber and first and second rotors. A lobe is mounted to the first rotor and a channel is defined in the second rotor. The lobe and channel cooperate to form a suction section which compresses the gas.

Support for the amendments to claim 39 are to be found in the specification at page 9, lines 29-32.

Mowli does not disclose a pump for a gas. Rather, Mowli's pump is designed for pumping highly viscous liquids and high solids content liquids. Mowli's upstream stage would serve no purpose in displacing a gas. Rather, it is a non-positive displacement stage, which simply operates to urge the flow of the liquid, which is already flowing downward, under gravity. The spiral threads **36** of Mowli, which the Examiner suggests serve as a lobe and a channel, do not cooperate to form a suction section and do not compress a gas.

Accordingly, it is submitted that claim 39 distinguishes patentably and unobviously over the reference of record.

Claim 40 now calls for a vacuum pump with a non-helical lobe mounted to the first rotor adjacent the inlet port and a channel defined in the second rotor adjacent the inlet port.

Support for this amendment is found in FIGURES 12 and 13 and in the specification at page 12, lines 31-36.

The Examiner suggests that the flights **36** of Mowli serve as a lobe and channel. However, these flights are helical. There is no suggestion of making them non-helical, as presently claimed.

Further, claim 40 now calls for a positive displacement suction section. Mowli specifically calls for the Archimedian section to be a non-positive displacement section.

Accordingly, it is submitted that claim 40 distinguishes patentably and unobviously over the reference of record.

Claim 41 now calls for a vacuum pump including first and second lobes and first and second channels. The first lobe is radially offset from the second channel.

Support for this amendment is found in the specification at page 8, line 21-23, and in FIGURES 12 and 13.

There is no suggestion in Mowli of a rotor with a first lobe and a second channel wherein the first lobe is radially offset from the second channel. Any portions of Mowli's device which the Examiner asserts are a lobe and a channel are helical and thus not radially offset from one another.

Accordingly, it is submitted that claim 41 distinguishes patentably and unobviously over the Mowli reference.

Claim 45 calls for providing a lobe abutting an inlet end of the helical thread of one rotor and a channel at the inlet end of the helical thread of the other rotor which are matingly engaged. Since Mowli makes no suggestion of a lobe with a constant profile in an axial direction, it is submitted that **claim 45 and claims 46-47 dependent therefrom** distinguish patentably and unobviously over the references of record.

CONCLUSION

For the reasons set forth above, it is submitted that claims 1-47 now distinguish patentably and unobviously over the references of record and meet all statutory requirements. An early allowance of all claims is requested.

In the event the Examiner considers personal contact advantageous to the disposition of this case, she is requested to telephone Thomas E. Kocovsky, Jr. at (216) 861-5582.

Respectfully submitted,

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Theory and Practice of Vacuum Technology

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5 Positive displacement pumps

5.1 Summary (see table 5.1)

The positive displacement pumps are the most important types of pumps for vacuum technology. According to DIN 28400, part 2 (1980), (and equivalent standards, such as BS: 2951 pt 1 (1969), and the AVS and ISO definitions) the positive displacement vacuum pump is defined as "a mechanical vacuum pump into which the gas is drawn, it is compressed and discharged by the periodic variations in volume of the working chamber of the pump by means of pistons, rotors, sliding vanes etc., it is sealed with or without liquids (such as oils) and has suitable valves at the inlet and outlet."

The simplest form of positive displacement vacuum pumps are the reciprocating piston pumps (fig. 5.1). These were among the earliest with which pressures lower than atmospheric pressure could be obtained. In the construction of these pumps even with the most careful construction, it is unavoidable that at the highest reversing point of the piston, the dead centre, a dead space remains from which no air is transported through the exhaust valve; this limits the ultimate pressures achieved. The gas remaining in this dead space at the exhaust pressure, subsequently expands at the next stroke of the piston to fill the compression chamber partially (or completely), thus limiting the intake of new gas. A positive displacement vacuum pump with dead space is therefore limited in its compression ratio by the ratio of maximum displaced working volume to the dead space volume.

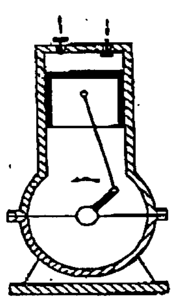

Fig. 5.1
Schematic diagram of a reciprocating piston pump.

As the dead space is only that volume filled with gas at the end of the displacement stroke, the compression ratio of a reciprocating piston pump may be enhanced considerably if the dead space is filled with oil and, will then produce greatly improved vacua, i.e. much lower ultimate pressures. There remain, however, other disadvantages (such as the heavy weight and relatively large size of such pumps) so that reciprocating piston pumps are today only rarely used.

The situation is, however, rather different in the case of the rotary piston positive displacement pumps. These are very widely employed, both industrially and in research; they are of a variety of different designs (as indicated in Table 5.1).

Table 5.1 Subdivision of displacement type vacuum pumps according to DIN 28400/pt 2 (1980).

Displacement vacuum pumps

oscillating-displacement pump	rotary displacement pump[1])
piston pump (5.1)	liquid ring vacuum pump (5.2)
diaphragm pump	sliding vane pump (5.3.1) – multi-cell
	sliding vane pump (5.1)
claw pumps	cylindrical rotary piston pump (5.3.4)
screw pumps	rotary piston pump (5.3.2)
	Roots type rotary piston pump (5.4)

Low pressures may be readily achieved over a wide pressure range (as indicated in table 16.11) by the use of oil sealed rotary–positive displacement, rotary sliding vane and rotary-piston pumps (see Sections 5.3.1 and 5.3.2). They are employed throughout the rough vacuum and far into the fine vacuum region. The pumps are characterized by a crescent shaped exhaust and compression volume. In rotary vane pumps these are separated and sealed from each other by the sliding vane, while in a rotary piston pump they are sealed by an eccentrically placed rotary piston.

During the operation of the pump, the crescent shaped exhaust volume is periodically reformed, always increasing in volume from zero. So, in these pumps there is no dead space and–supported by oil seals as well as an oil coverage of the exhaust valve–a high pumping speed (volume flow rate) can be achieved right into the fine vacuum region.

A subdivision of the oil sealed sliding vane pumps, usually provided with two or three sliding vanes, is the multi-cell sliding vane (vacuum) pump, also known as a multi-(sliding) vane pump. Such pumps are provided with a large number of sliding vanes and are usually operated without any oil filling. Their operation at the lower exhaust pressures is therefore limited (see table 16.11). Multivane pumps are mainly used in the rough vacuum region (ultimate pressures down to about 50 mbar). They are also used for the production of moderate over-pressures, i.e. above atmospheric pressure.

In another wide-ranging field of applications, covering the intermediate vacuum range ($p = 1 \dots 100$ mbar) the liquid ring vacuum pump has been effectively employed, especially for industrial chemistry applications (see Section 5.2).

In recent times, the cylindrical rotary piston pump principle has also been exploited in the application of vacuum technology. In a new design of a vacuum pump it became possible to combine the advantages of the rotary piston with those of the sliding vane pumps. In view of the mathematical curves involved in their design, they have become known as trochoidal pumps (see Section 5.3.4).

For requirements mainly in the medium vacuum region, *Roots type rotary* piston pumps are widely used–they are named after Roots who first employed this design in compressed air usage (see Section 5.4). In this type of pump two symmetrically arranged pistons roll to-

[1]) In earlier literature also denoted as rotating piston (vacuum) pumps